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REPORT

ON THE

OPERATIONS CONNECTED

WITH THE

HINDOSTAN AND THIBET ROAD,

FROM 1850 TO 1855.

By CAPTAIN D. BRIGGS,

Superintendent of Hill Roads.

Calcutta:

THOS. JONES, "CALCUTTA GAZETTE" OFFICE.

1856.

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APPENDIX.

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UNDER instructions from the Most Noble the Governor General of India, I proceed to lay before the Government a detailed account of the operations connected with the Hindostan and Thibet Road, from the date of its commencement in 1850 to the present time, with which will be incorporated any Reports of general interest, which may have been submitted by me to Government during that period; and as this document would be incomplete, unless it afforded information as to what still remains to be done to facilitate the intercommunication of countries between which nature has imposed such gigantic barriers as the Himalayas, I shall in conclusion give an approximate estimate of the probable expenditure, in time and money, as far as can be deduced from an examination of the country and the data afforded by previous operations.

2. In the Spring of 1850, a variety of circumstances combined to attract the attention of the Most Noble the Marquis of Dalhousie, Governor General of India, to the oppressive practice of "Begar," or *forced labor*, prevalent in the protected Hill States, which occupy that portion of the Himalayas situated between the Rivers Sutledge and Jumna.

This species of serfdom had been general throughout these principalities from time immemorial, and was doubtlessly introduced, not only as a substitute for Revenue in the absence of other means of taxation, but because the exigencies of the Chiefs required the entire disposal of the time and labor of their subjects in Peace as well as in War. As long as the Chiefs were solely dependent upon their subjects for support, and

were only preserved by their help from the encroachments of their warlike neighbours, the union between them was such as to ensure the subject a certain amount of consideration from his Chief; else would the subject transfer his allegiance to another and more politic master. Since however the British Government extended its protection to these States in 1815, these relations have changed, and the serf being no longer necessary to the safety and support of the Chief, (these being sufficiently guaranteed by the paramount power of the British Government,) has lost the balance of power he formerly possessed. Without dread of interference, (which the nature of our Political relations precludes,) the Chief may now at his pleasure increase his demands upon the time and property of his subjects. True it is, the latter may appeal against his oppression to the Superintendent of Hill States, but from the nature of existing Treaties that Officer has in general no course to pursue, but to refer the case back to the Chief against whom the complaint lies, with what hope of obtaining justice for the oppressed I need not say. Thus "Begar," or unremunerated forced labor, as the term implies, is a system of the internal Government of the Hill States.

3. In 1815, Sir David Ochterlony, finding the Hill States impoverished to an immense extent by the protracted invasion of the Goorkas, thought it sufficient to impose upon the Chiefs whose countries he restored a recognition of our paramount authority in the shape of a trifling annual tribute, and the duty of providing "Begar," whenever the exigencies of the State required it.

And foreseeing with his wonted sagacity the only means by which the condition of the inhabitants of the fertile valleys embosomed within the Himalayas could be ameliorated, he added to the engagements of each Chief the obligation of constructing roads 10 feet wide, in whatever direction the British Government should desire them, within their own Chiefships. For thirty-five years, or up to 1850, this last condition had remained a dead letter. With the exception of slight improvements made in the different Hill paths communicating between the residences of the several Chiefs and Simlah, these improvements, except in a few instances, effected no change in the mode of carriage throughout the Hills, as they were confined to the widening of old pathways adopted before the employment of beasts of burthen had been thought of by the Hill-men, and were consequently of a gradient impracticable to all but themselves.

The second condition had therefore of necessity been more generally exacted, as the exigencies of the British Government, within these States, became yearly greater. When the Sanataria of Simlah, Subathoo, Kussowlie and Dugshai, (which have proved of such inestimable benefit to thousands of Europeans), were established, great and continuous was the demand for labor in all shapes. In the absence of other carriage, thousands of porters were yearly required for the conveyance of Government establishments, invalids, and their numerous servants, troops and camp followers, supplies and merchandise, from the plains to the Sanataria, and thousands were again required a few months afterwards to convey the same down again. Barracks were required for the troops, hospitals for the invalids, and materials for their construction had to be brought by the unassisted efforts of men from glens and mountains 10 miles in the interior. To assist in these laborious tasks, the people of the plains were found to be perfectly unfit. The long rugged ascents and narrow tortuous foot-paths of the hill-men were scarcely practicable to them under any circumstances, wholly impossible when laden. Thus the whole duty fell upon the scanty population of the Hill States, and heavy and grievous was the burthen. "Begar" was claimed by their own Chiefs. "Begar" was an obligation owed us by their Treaties of 1815; and although to the credit of our Government be it spoken, they never were called upon to work without receiving remuneration; yet what amount of wages could remunerate a man for being dragged against his will from his home and family, without warning, without consideration, (for what Government Native Official has consideration when armed with his master's warrant?) to a distance of many days' journey, there to wait weary days, without shelter, without his usual food, until his services were required; then to be laden as a beast of burthen, to be insulted, to be buffeted by the low dependent of an European master, until the time of his slavery was accomplished, when he was suffered to depart with feelings mortified and wounded to his distant valley, there perhaps to find that seed time or harvest had passed during his absence, and no provision been made for his unhappy family.

It might be supposed that the influx of large sums of money within a limited period must have tended to enrich the population and so reconciled them to the evils of "Begar." But, as previously shown, the system of our political relations with the Chiefs allows of an "*imperium in imperio*," and thus deprives the subject of any protection against the tyranny and mal-practices of the Native Authorities of the

State to which he belongs. The consequence is, that no amount of care on the part of the Disbursing Officer ensures to the "Begaree" the permanent possession of the wages paid to him. I have been assured by the late Superintendent of Hill States, Mr. William Edwards, that having on one occasion a large sum to disburse to subjects of the Hindoor State, he attended in person and saw the money put into each man's hand; notwithstanding which, he afterwards discovered that the Kardars of that State took from the unfortunate men all that he had been so careful that they should receive.

4. Besides the cruelty of the system, it was to our Government a most expensive one. I have learned from the Superintendent of Hill States, that the sums disbursed on account of the carriage of the Government Establishments, from 1820 to 1852, to and from Simlah, amounted to seven lakhs of Rupees. The cost of the barracks and other buildings for one Regiment at the Dugshai Sanatarium has amounted, I understand, to six lakhs of Rupees.

Taking the same sum as the cost of each of the other Sanataria of Kussowlee and Subathoo, and one lakh of Rupees for other buildings, the expenditure on Public Works within the Hill States has probably not been less than nineteen lakhs of Rupees*.

From personal experience I will venture to state that the chief item of expense in these works was carriage of material, and yet there is no country in the world where building materials are more abundant. Stone, lime, and wood, exist in profusion within a circuit of 10 miles, and all that was wanted was the means of carrying it.

To the Officers and servants of the Government, who annually visit Simlah and the neighbouring Sanataria for the recovery of their health, or on duty, and average about 500 persons, the cost of the journey and the high price of supplies becomes to many a most serious consideration. The cost of the transport of stores and supplies from the plains to Simlah, a distance of 42 miles, averages about three Rupees per hundred-weight, a sum which ought to suffice for the carriage of the same weight for a distance of one thousand miles.

Had carriage roads been at once constructed, Government would have saved 50 per cent. upon the past outlay, which, as will be shown here-

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* This is immensely over-estimated. The statement in the text suggested enquiry, and the expenditure on the three stations (excluding the *new* barracks in progress at Kussowlee) does not appear to have exceeded half the sum named in the text.—*Ed.*

after, would have sufficed for the construction of 500 miles of carriage road, and the servants of Government with their families who have visited the hills might have returned to their duties with renovated health purchased at a less ruinous cost.

5. It remained for the Most Noble the Marquis of Dalhousie to initiate arrangements, having for their object the construction of roads that would admit of the transport of baggage on four-footed animals or carts, and thus render the agency of human beings in employments so degrading unnecessary.

And with this view his Lordship, in the Spring of 1850, sanctioned the commencement of a road, which, leaving the plains in the neighbourhood of Kalka, 36 miles from Umballah, should ascend to Simlah, having branch lines to the Stations of Dugshai, Kussowlee, and Subathoo. Further, as a part of the same project, his Lordship directed the continuation of the line beyond Simlah towards Thibet through the temperate valley of the Sutledge, with the two-fold object of affording an easy entrance into the justly celebrated salubrious valley of Kunawur and of opening a direct commercial intercourse with Central Asia and Western China, and thereby directing into our own Provinces the trade at present monopolized by Russia. As it was expected by the terms of the Treaties of 1815, that these works, so humane and important in their object, would be effected by the Hill Chiefs, the continuation of the line beyond Simlah was a measure of good policy, as it would have been objectionable to have called upon a *few*, and not upon *all*, of the Chiefs for assistance, and it would have been but a continuation of the worst feature of the "Begar" system to have demanded the attendance of the subjects of Bussahir and other Northern Chiefships to the South of Simlah, so many miles distant from their own districts.

6. It is here necessary to show that this was the best line that could have been selected between Central Asia and Hindostan, whether considered mathematically, commercially, or politically—the more so, as it is one that has not been hitherto so generally adopted by merchants as other routes. Viewing Lé on the Indus as the entrepôt between Central Asia and Hindostan, we find five different routes from it to the plains, *viz.*, two to the South-West through Kashmir, one to the South through the East India Company's Territories of Lahul and Mundee, and two more Easterly branches of this last through Spiti and Bussahir.

The first two are according to Cunningham 350 miles in length. The most westerly crosses the Passes of Namyika, Photo-la, Pir Punjal, and Ratan-Pir, varying from 12 to 13,300 feet in height. The other is still more difficult and crosses five Passes, respectively, 16,952, 16,495, 18,125, 14,794, and 10,165 feet in height. The southern road is 370 miles in length and crosses the Passes of "Tung-Lung" (17,500 feet,) "Lunga-Lacha" (17,000 feet,) "Bara-Lacha" (16,500 feet) and "Rotang" (13,000 feet). The two more Easterly branches are respectively 434 and 479 miles in length, the first of which crosses five Passes, varying from 15,282, to 18,502 feet in height, and the second encounters the same number of obstacles, varying from 14,821 to 17,500 feet. The great elevation of these Passes necessarily renders the several lines I have named impracticable during many months of the year.

They also, with their corresponding depressions, render even an approximately true mathematical line impossible, and two of them, from lying within a Foreign State, are politically objectionable, even had they possessed other superior advantages.

7. But Lé is not the most conveniently situated spot for a commercial entrepôt between Central Asia and Hindostan. It has certainly long enjoyed this distinction, but rather on account of the despotic influence of its rulers and the jealous care with which they have directed the trade of Central Asia towards their own territories, than for any advantage the place itself possesses. The chief products of Central Asia are shawl and common wool, borax, sulphur, and churrus.* With the exception of churrus, which is brought from Yarkund, each of these articles of export is more largely produced in the districts of Chang-Tang and Rudok than elsewhere. These districts lie 300 miles to the Eastward of Lé, so that *this* distance must be added to the length of the above-mentioned routes in calculating the distance which the produce of Central Asia has hitherto been carried to reach an Indian market through that entrepôt. Churrus, and a limited quantity of the finest shawl-wool, come from Yarkund, and find a convenient entrepôt in Lé, but not so the produce of Eastern Thibet.

Tea, another important article of trade, is brought entirely from the Chinese Dominions to the Eastward. A glance at the map will show how circuitous is the route to Hindostan *viâ* Lé from the Thibetan

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* An intoxicating exudation from Hemp flowers.—*Ed.*

Provinces of Chang-Tang and Rudok and from the productive Districts of Western China. It will also show, that from the rich mineral and silk-producing Provinces of Khoten and Akson, an imaginary line may be drawn through Rudok and Chang-Tang, to the plains of India, considerably shorter than if drawn through Lé, or indeed through any other given point.

The British protected Hill States lie comparatively contiguous to Chang-Tang and Rudok and are bisected by such a line.

There is another line from Thibet to Hindostan used by merchants from the Eastward—that *viâ* the Niti Pass, through the Almorah district. It does not afford so direct a communication with Thibet as the one we have adopted, but is more convenient with reference to L'hassa and Western China. The Niti Pass, however, (nearly 17,000 feet high), will ever prove an insuperable obstacle to regular and active trade. It therefore appears beyond a doubt, that the best line between Thibet and Hindostan, whether in a commercial, mathematical, or political point of view, is one from the uplands of Chang-Tang through Bussahir and Simlah to the plains near Kalka. Here, and here only, has the awful barrier of the Himalayas been pierced, and its ramifications threaded, by the waters of the Sutledge, so that passes of great elevation do not present themselves and the mathematical correctness of the line is not impaired.

This is the line that has been adopted for the Hindostan and Thibet Road, and I believe that the most sceptical will now allow that it is the best that could have been selected and the best calculated to improve the commercial relations of the two countries. When completed, the keen reproach uttered by Moorcroft thirty-five years ago will have lost its point and applicability. " The Thibetans," wrote this adventurous traveller, " have their flocks and herds in abundance, provided with " wool of peculiar properties and admirably adapted for the finest manufac-" tures. They have also some natural products of value—salt, borax, " natron, and gold. They have no manufactures, and rear an inade-" quate supply of food. The latter can be plentifully supplied from the " British Provinces of India. Whether they shall be clothed with the " broadcloth of Russia or of England; whether they shall be provided " with domestic utensils of copper, iron, or pewter; with implements of " iron and steel; with hard-ware of every description, from Petersburgh " or Birmingham—is entirely in the decision of the Government of Bri-

" tish India. At present there is little doubt to which the prize will
" be awarded, for enterprize and vigor mark the measures of Russia
" towards the nations of Central Asia, whilst ours are characterized by
" misplaced squeamishness and unnecessary timidity."

8. The project of uniting Hindostan with Central Asia by a great commercial line having been determined on, but before operations had been commenced, Major (now Lieutenant-Colonel) J. P. Kennedy, Military Secretary to Sir Charles Napier then Commander-in-Chief in India, an Officer of great talent and European reputation as an Engineer, proffered his services as temporary Superintendent of the new road. The principles upon which he determined to conduct the duties of superintendence had for their especial object the following results:—

First.—The best mathematical line of road, with especial reference to levels.

Second.—The construction of the same at the smallest possible cost.

His first care was to obtain accurate information regarding the country through which the proposed road was to run. Reserving to himself the examination of the country to a distance of 40 miles on either side of Simlah, he deputed me to examine the country towards Thibet. The result of our examination was that no condition of the first principle need be vitiated, but that from the difficult nature of the ground the second principle would be considerably affected by the scrupulous observance of the first. Major Kennedy considered the importance of the first principle of too much consequence to admit of modification, but I feel confident that greater experience of the astounding obstacles presented to a level road by the Himalayas, and the number and depth of the inflections, which add so much to its length, would have induced him to admit as a condition of the best mathematical line, *economy in distance.* At any rate, I have found it necessary in practice to admit of such considerations, but at the same time have been careful that they should not be allowed to effect the general correctness of the line.

9. To those who have examined the Himalayas, it will be known that they conform to a system of river basins, and dividing ridges, generally extending at right angles to the main chain. These ridges, from their numerous subordinate ramifications, (each pair of which form their own tributary basin,) present to the uninitiated eye a confused mass without system or arrangement. Yet, between each principal artery, exists a connected chain of Mountains from the snowy range to the plains of

Hindostan. Between the Sutledge and Ganges, there are four such connected ridges, forming the water-shed lines between the four great rivers, the Sutledge, the Tonse, the Jumna, and the Ganges. It requires no demonstrative proof to show that these ridges afford the best mathematical lines for a road, as they present unbroken bases, intersected by no water-courses. If the elevation of these ridges was gradual in its increase as they approached the main-chain or snowy range, there would be little difficulty in constructing a roadway along their water-shed lines, but the incline is by no means regular. On the contrary the outline of each ridge consists of a series of rising peaks and corresponding depressions, and it is a singular fact that in many instances the ridges are capped, near to where they subside into the plains, by peaks of greater altitude than the generality of those rising from parts of the range nearer the snows. In like manner, the depressions, or passes, on the ridges, are irregular in their elevation, and those nearest to the snows are frequently of less altitude than others on the same range nearer to the plains. It is therefore apparent, that if a road were constructed so as to follow the crest of the ridge, it must conform to these rises and falls, and consequently would not be mathematically correct, as the first condition of *such* a line is, that it shall not rise or fall unnecessarily. A *perfect* hill-road must therefore be laid out with reference to these lowest, or "obligatory" points, and instead of mounting over the intervening peaks, must pass round or cut through them. Two objections may be raised to the practical application of the above principle; *first*, the increased length and tortuous course which is given to the road by passing *round* instead of *over* such impediments; *second*, the necessary destruction of a portion of the hill to afford the roadway, which thereby deprives a part of the hill-side of its natural base and renders the bank above the road liable to slip and fill up the roadway. Both objections are good, but the first is capable of considerable modification by the judicious construction of the road, and the second continues to exist only until the bank resumes a slope which will admit of the earth remaining at rest.

10. Applying the above principles to our investigations, we selected the line shown in Map No. 1 which accompanies this. The maximum gradient permitted was 1 foot in 33⅓ or 3 feet in 100. In but a very few places have I thought it necessary *permanently* to increase this gradient, and then only in order to effect

a great saving in distance. No permanent sacrifice of principle was admitted to avoid natural difficulties, such as precipices, deep ravines, &c.; but in future operations within the Himalayas, I would recommend that this point should receive due attention, as not unfrequently a scarcely appreciable deviation from the true gradient will enable the Engineer to escape difficult ground and so effect a reduction of expenditure. In order to show the impossibility of availing ourselves of any portion of the old road, I have, in Map No. 2, given sections of both the old and new roads between the plains and Simlah, which will convey more just ideas of the relative difference betwixt the two, than any thing I could write on the subject.

11. It will be seen that the new line leaves the plains in the neighbourhood of Kalka, and gradually ascends, for 14 miles, to a gorge in the extensive range of hills which border the plains and extend from the Sutledge to the Jumna. On the left lies Kussowlee, 6 miles distant, and nearer, and overlooking the gorge, stands the Lawrence Asylum. To the right is Dugshai, close under which the road winds to the low neck of land which connects the long outer range, above mentioned, with the main body of the Himalayas. Here an abrupt spur thrown off to the eastward, at right angles to the desired direction, renders a tunnel of 1,900 feet necessary. From this the line runs to the next obligatory point near the rich valley of Solon, which it enters at a spot eminently calculated for a large European settlement; it then skirts the southern flank of the Krole Mountain, and running through the next obligatory point at Kundah, commences an ascent of 5 miles to Kearee Ghât, passing above the fine valley of Bhagurree. From this it runs nearly level, through the volcanic cliffs of Tara Devi, to an obligatory point within 4 miles of Simlah, to which it ascends at a gradient of 1 in 25, steeper than any on the whole line, but rendered necessary by the elevated position of the Sanatarium. Two and a half miles beyond Simlah, after emerging from the fifth obligatory neck, another rugged spur running to the South-East renders a tunnel of 550 feet necessary; from which the line runs at an imperceptible gradient, for 40 miles, to the Nagkundah Pass, 9,300 feet above the level of the Sea. From this, skirting the Northern face of the massive Huttoo Mountain, it holds a level course to the obligatory point under Bagee; from which an easy ascent brings it to the highest point on the line at Kundrelah, which has an elevation of 9,660 feet. Descending to the obligatory Soongree

Pass, it turns Northward to avoid the snow limit of the Himalayas, and seeks the valley of the Sutledge. Skirting this at a general elevation of 6,000 feet, (temporarily vitiated by the tremendous cliffs bordering the Nogurce torrent,) it crosses the Sutledge River above the old bridge of Wangtoo, from which it ascends to the village of Chini, unrivalled for the beauty of its scenery and the salubrity of its climate. Gently descending in order to avoid the deep inflections of the snow-fed tributaries of the Sutledge, it runs through the rich vineyards of Rarung and Akpah, until it again meets the Sutledge under the towns of Soongum and Kanum, renowned no less in the ecclesiastical history than in the commercial estimation of Thibet and Western China. Under Sapooce the line again crosses to the left bank of the Sutledge, now flowing at an elevation of 8,300 feet, and taking advantage of an old bed of that most turbulent stream, 100 feet above its present level, it emerges on the Highlands of Thibet near the Chinese village of Shipké, from which roads as old as the people themselves run East, West, and North, traversed by baggage cattle of all descriptions. But it must not be supposed that the ease with which I have sketched the direction of the line affords any adequate notion of the extent or nature of the obstacles which oppose the construction of a road. In presenting a summary view of these, I cannot do better than accompany it with such remarks on the geological formation of the country as my limited knowledge of the science will permit; for there can be no surer criterion of the natural obstacles which oppose the Road Engineer's progress.

12. On leaving the elevated plain (composed of loose conglomerate and alluvium formed from the detritus of rocks) lying between the Sewalik Range and the outer spurs of the Himalayas, the line enters a series of indurated sand-stone piled in confused masses. The angle formed by the mountain side varies from 30° to 35°. This continues for about 5 miles from Kalka, where the line enters the basin of the Kossilah and its tributaries, when the slope of the hills becomes less abrupt, so that all the minor spurs have been reduced to terraces for the purposes of cultivation. Higher up, the spurs are capped by masses of granite and other inferior rocks, forming hard, and difficult walls through which to excavate a road. As the line approaches the summit of the extensive ridge between Dugshai and Kussowlee, the slope of the hills assumes an angle of 40°, and their composition is generally of broken and detached masses of granite, imbedded in stiff ferruginous

clay, frequently intersected with walls of gneiss and over-lying beds of indurated sand-stone, forming obstacles of considerable magnitude from their excessive hardness and frequent recurrence. Perched above the gorge at Dhurmpoor, at an elevation of 4,900 feet, is an extensive mound of half-baked stratified rock, abounding with fossiliferous remains, especially shells of the Spirifer Walcotii, Gryphæa Oblignata, G. vergula, G. dilatata, Podopsis trunculata, Turrilitis tuberculatus, and others which I have been unable to identify. The formation of the Dugshai Hill, and that through which the long tunnel is necessary, appears outwardly to be of granite masses and gneiss walls, but our excavators have exposed thick beds of graphite and marl, which, from their want of consistency and the quantity of water they contain, have considerably retarded the progress of the miners and rendered a partial lining of the tunnel necessary. On the spur to the North of this tunnel, the line runs through masses of yellow sand, argillaceous lime-stone, and other deposits of the Oolitic system. The argillaceous lime-stone is so regularly stratified as to form perfect rectangular blocks valuable for building. A white efflorescence (probably muriate of soda,) occurs in the Graphite under the lime-stone. Above this are immense masses of coralline magnesian lime-stone of fantastic shape, in places overhanging the road. The Krole Mountain is almost entirely composed of this mountain lime-stone, full of fissures and caverns. From its toughness and numerous cavities, it is very difficult of reduction and consequently offers great resistance to the excavators. Between the Krole and Tara Devi Mountains the formation is of clay slate, finely laminated but much broken. The slope of the hill side is generally about 40°, which renders the cuttings for a road-way heavy. On this, from its Southern exposure, no tree vegetation appears to thrive, but the hill side annually produces a valuable crop of natural grass, and further down in the valley, where the detritus has accumulated, much fine cultivation has ensued.

The Tara Devi Mountain is of volcanic origin, and composed of several of the primary rocks fused into a conglomerate mass. It appears either to have cooled irregularly, or after cooling to have been the scene of fresh volcanic agency, as mass is detached from mass by extensive fissures, the edges of which are not of a sharp or broken appearance, as if caused by fracture from convulsions subsequent to their formation, but rounded as if the masses had been rubbed against each other.

The composition of one such contiguous mass is frequently different from the composition of another, and the fissures are in many places lined with crystals of sulphur, iron, and other minerals. Mounds of black scoriæ are here, as also on the Krole, frequent in occurrence.

Here also a bright vermilion powder of considerable demand amongst the natives is found, and at another place quartz veins impregnated with iron pyrites of a bright golden hue gave hopes to many of the discovery of a new gold field. Along the whole extent of the Tara Devi Mountain and its neighbourhood, the cliffs are lofty and very precipitous, presenting obstacles of great magnitude to a road.

Of the formation of the ranges between Simla and the uplands of Thibet, I need say little, as they are all of the Mica slate, and gneiss series, crossed but seldom with any other element interesting to the Geologist. This formation is however pregnant with difficulties to the Engineer. The Mica slate is piled up into precipices of many hundred feet, and the gneiss is exposed in not less precipitous masses of thousands of feet in extent. Neither, from being stratified, is favorable to blasting operations, and both have been already too severely tried to yield to fire and water. Veins of quartz piercing every description of rock form a net-work throughout the whole of this formation. Near Mahasoo, at an elevation of 7,000 feet, an extensive bed of lime-rock lies above the slate. At Kundrelah, the Mica slate is strongly impregnated with iron ore, but this will be more particularly described hereafter, when treating of the iron mines opened out by the road.

Throughout the Gneiss and Mica slate series, the hills are most rugged and abrupt, breaking into extensive cliffs and intersected with narrow and precipitous glens. The action of the weather on their rugged outlines causes constant demolition, and the consequence is that rocky avalanches of enormous size not unfrequently descend with crushing force, carrying ruin and devastation in their impetuous course. The thin super-stratum of soil lying on the sharp incline of the slate hills, in severe seasons, becomes saturated with moisture and loses its adherence to the slate-stratum underneath. It then frequently slides upon its base and deposits its load of forest trees and surface rock in the glen below, leaving a shelving precipice of bare rock where formerly existed a rich forest.

All these serve to increase the difficulties attending the construction of a mountain-road, where the principles of gradients are strictly observed.

13. The preliminaries having been arranged, operations were commenced on the Hindostan and Thibet road in the month of July 1850. I will not here detail the mechanical operations connected with the construction of the road, but have in Appendix A. given Major Kennedy's excellent instructions on the subject of "Road making in the Hills."* In the manner therein described, a five (5) feet mule-track was commenced at several points on the line. It has been frequently remarked with reference to this road that it would have been a wiser plan to have finished one portion of the road and opened it to the Public, instead of commencing on a number of unconnected portions unavailable for traffic; the reason is to be found in the nature of the labor employed. Each State furnished its quota of labourers, and as it would have been an unmitigated hardship to have demanded their services at a great distance from the boundaries of their States, they were employed at that point of the line which lay nearest to their homes.

Hence the commencement of work on a number of detached portions.

14. Major Kennedy, in his letter to Government, dated the 17th September 1850, fully details the means he took to obtain the efficient performance of his duties, from every individual employed on the road. That he was eminently successful admits not of a doubt, but that the sanguine expectations entertained in that letter should be realized was simply impossible. He there stated that there was little doubt but that the whole line from Kalka to Chini, in the valley of Kunawur, might be made passable for loaded animals by November 1850, that is, that a nearly level road, 5 feet wide and 200 miles in length, might be constructed through the most precipitous chain of mountains in the world within a period of four months. Major Kennedy had only inspected the lower hills. He had not examined the two miles of sheer precipice at Mutteeanah, the walls of perpendicular rock lining the Nogaree and Munglad, the Rogee abyss, or indeed any portion of the line in the rock valleys of Bussahir and Kunawur. The work actually constructed within these four months was the opening of 50 miles of an irregular path, just passable for horsemen, between Simlah and Dugshai. Where cliffs occurred, they were avoided by temporary ramps, made either over or under them. Twenty-five miles of similar path-way were constructed between Simlah and Chini, but as intervening cliffs were not reduced, no portion of it was available for traffic.

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* This has been omitted, having already been published in a separate form.—*Ed.*

15. I must here observe that I have learned from experience how erroneous is the system of opening out a hill-road to a less width than what is eventually contemplated. I do not mean that no lock-spit should be made, for without it the road would not be kept level, but I object to opening the road first to 5 feet, then afterwards to 12, and then perhaps to a greater width. In opening the road to a width of 5 feet, the excavators with great labor, blast, and chip off just enough to afford the path-way required, and the debris falls down and fills up the re-entering angles. When it is required to increase the width, the laborers have to re-commence to excavate the bank above the former cutting, and to perform the same operation as was required for the 5-feet road; only that the labor is increased in ratio to the increased dimensions of the section. From the accumulation of the debris of the first cutting the natural bank below the road is hidden, and much labor is expended in removing the rubbish to commence the excavations for the foundations of the revetment walls. It is my opinion that, after the cutting of the lock-spit, the intended width of the road-way should be finally determined, and the foundations of the retaining walls laid out and excavated at once. The cutting into the hill-side may then be commenced, the fragments of rock being used for the walls as they are dug out. By this means all unnecessary labor will be avoided, the sharp angular turns in the road will be reduced to a minimum, and the foundations of the walls, from being cut out of the unbroken hill-side, will be stable.

16. The number of laborers employed* in the construction of 46 miles of Major Kennedy's path-way was 80,966, or an average of 1,730 laborers per mile. The cost at the market rate of 2 annas per man would have been Rupees 216-0-0 per mile. The actual cost to Government in consequence of the amount of tribute labor at that time supplied, was only Rupees 147-0-0 per mile.

17. In December 1850, after Major Kennedy's return to England, I commenced the widening of the Simlah and Dugshai track to 12 feet, correcting all irregularities of gradient which had previously been allowed, in order to avoid difficult ground, throwing bridges over the principal torrents, and erecting staging bungalows. It was now found that the labor provided by the Hill States in terms of their Treaties, was such as to

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* *i. e.* the number of single day's wages earned, or single day's tasks done.—*Ed.*

render it impossible for the British Government long to avail themselves of it.

Sir David Ochterlony's Treaties were looked upon as a dead letter by another generation than that which had benefitted by his mild rule, and the Chiefs obeyed with evident reluctance the orders of the Political Agent for the assemblage of working parties.

That Officer (Mr. W. Edwards of the Bengal Civil Service), had been highly instrumental in bringing to the notice of the Governor General the evils of the Begar system, and insisted on the construction of roads as the only means of reforming it. The assessment of the quotas of laborers exigible from each State for the construction of the road was entrusted to his care, and Appendix B. will show how careful he was to make it with reference to the size and population of the States, so as in no instance to exceed 1 per cent, and in few intances ½ per cent, of the population. But all his efforts failed to enlist the good will of the Chiefs towards the work, and although from dread of the consequences of disobedience, they furnished a considerable body of laborers, they adopted no means for their support, and did their utmost to make the work unpopular with their subjects. The *finest* sophistry could hardly lead to the supposition that the Treaties did not oblige the Chiefs to pay the laborers they were bound to supply, for where would have been the necessity for any stipulations in their Treaties, if the British Government were themselves to bear the cost of the roads they desired to construct? Yet of the nineteen Hill Chiefs who furnished laborers, not *one* yielded the smallest support to them whilst employed on the road, and ere four months had elapsed, it became evident that the British Government must take the burden on their own hands, if they would not have the work stigmatized in common with the Mahmoudieh Canal, or like works constructed with the blood and sinews of a starving people.

From that time every laborer has received from the hands of Government Officials 2 annas per diem, the market rate at which laborers are paid in the North-Western Provinces.

For a time an endeavor was made to enforce the payment of a moiety of the wages of each party by the State to which it belonged, but after about Rupees 40,000 had been so obtained during a period extending over four years, from the States as per margin, it was deemed best to discontinue it, and the British Government have ever since paid from their own coffers

Keonthal.
Putteealah.
Komharsen.
Bussahir.

every man engaged on the work, so that the Treaties of protection, under which the Hill Chiefs have enjoyed thirty-five years' uninterrupted tranquillity, have failed to obtain for the British Government any adequate return for the heavy expense that protection has cost them.

18. It would be tedious to describe each of the many works which were necessary in order to form a nearly level road-way of 12 feet in width through the difficult country before described. I will merely mention a few of the works of greatest magnitude, plans of which accompanied my Report of the 1st October 1852. The most expensive undertaking was the reduction of the extensive range of cliffs which line the Western flank of the sacred Tara Devi Mountain. These extended for a distance of nearly 2 miles, varying from 50 to 200 feet in height. One portion of 400 feet in length was cut down to a depth of 150 feet, in order to obtain a sufficient breadth of road-way; another portion, 300 feet in length, was of such a height and so sheer, that in order to obtain a road-way, the reduction of the cliffs must have commenced 300 feet above the line of road. To this I preferred erecting a viaduct of 260 feet across the precipice. Under Prospect point near Simlah a series of cliffs 500 feet in length, and averaging 60 feet in height, were reduced by blasting, and a cutting of 100 feet in length and 50 feet in depth, was made through a sharp projecting spur. Revetment walls, varying from 10 feet to 50 feet in height, were built in many places. These were constructed of hammer-dressed stones, laid without mortar, having a general batter of one-fourth of their height.

I cannot give a better idea of the amount of work performed in opening the 40 miles of road between Simlah and Dugshai to a breadth of 12 feet, than by stating the cubic measurement of each description of work—

	Cubic Feet.
1*st.*—Of hard rock reduceable only by blasting, -	5,734,663
2*nd.*—Of slate, shingle, stones, and earth, - - -	14,170,417
3*rd.*—Of revetment walls, - - - - - - - - -	823,893
Total Cubic Feet of work, - -	20,728,973

The number of laborers* employed on this was 3,48,912, and the cost to the State for labor, Company's Rupees 31,049-9-6. There was a

* *See* Note, p. 15.

further sum of Company's Rupees 1,755-4-6 expended on artificers, of which class of laborers 5,610* were employed at an average rate of 4½ annas per diem. The cost of superintendence, including all staff salaries, Accountant's pay, and Overseer's staff allowance, was Company's Rupees 12,703-10-9.

There were other incidental expenses, for materials, books, and stationery, amounting to Company's Rupees, 3,877-9-1. The cost of tools and powder, which were supplied by Government, I have no means of determining ; the amount of powder expended was 40,000 lbs. By reducing the above to a mileage denomination, we have, as the average expenditure per mile—

		Co.'s Rs.	As.	P.
On labor, - - - - - - - - - - -	„	776	0	0
On artificers, - - - - - - - - -	„	44	0	0
On superintendence and accounts, -	„	320	0	0
On contingencies, - - - - - - -	„	97	0	0

or a total expenditure per mile of Company's Rupees 1,237-0-0. Besides the large viaduct mentioned above, eight wooden bridges, varying in span from 30 to 90 feet of the " American lattice" description, were constructed. They were only furnished with single trusses in the manner of " cattle bridges," as greater strength was not considered necessary. Heavy 24-pounder guns with carriages were taken over them with safety. These bridges, spanning a length of 662 feet, have cost Company's Rupees 9,000-0-0, that is, their cost per lineal foot has averaged Company's Rupees 13-8-0. They were constructed solely of *Deodar*, with oaken trenails. I do not however *now* think that they are well suited for the hills, as *Deodar* is not of a nature to withstand the great transverse strain the component parts of the lattice bridges are subject to, and the tremendous gusts of wind which sweep down the ravines of the Himalayas cause much undue lateral pressure upon the trusses. The largest bridge was thus blown down in 1853, but has been replaced without much additional expence by another of simpler description.

Staging bungalows of six rooms were built at Kearee and Solon, at a total cost of Company's Rupees 7,355-0-0.

19. These several works commenced in December 1850, were completed in September 1851, between which periods there were only 248

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* *See* Note, p. 15.

working days, in consequence of the severity of the winter and the long continuance of the rainy season. In October 1851, the Most Noble the Marquis of Dalhousie personally inspected the whole of the completed works.

20. The works since completed to the South of Simlah, upon the principles of those just described, are roads 12 feet wide, connecting the Military Stations of Dugshai and Kussowlee, and Dugshai and Subathoo, and the extension of the Hindostan and Thibet Road to the plains, the whole amounting to 78 miles of 12-feet road, constructed upon true scientific principles, through a country unrivalled in natural difficulties. The number of laborers employed has been 6,26,228,* and the total cost on account of labor to Government, Company's Rupees 73,971-9-6 or Company's Rupees 922-11-5 per mile. The widening of a part of this, between Simlah and the plains, to 16 feet, is now progressing, and ere six months elapse I have a right to expect that there will be no more difficulty in conveying goods upon waggons from the plains to Simlah than there is in conveying them from Allahabad to Cawnpore; only at one place will the draught be severely felt, and that will exist until the tunnel through the Chewah Range of Hills is completed. This tunnel, 1,990 feet in length, was commenced in January last, and notwithstanding the unfavorable nature of the hill, which deterred our progress until both entrances were arched with masonry, the gallery is now advanced 400 feet into the interior. The expenditure on labor up to the present time has been Company's Rupees 3,000-0-0.

The other heavy works which have been lately constructed, or are now in progress of construction, are, a viaduct of 420 feet in length, to correct an irregularity of gradient which had formerly been permitted near Tauk Cliffs; another of 100 feet at Kundah Ghât; and a bucen-post bridge of 45 feet span near Kearee. Besides the widening of the road to a minimum breadth of 16 feet, a parapet of rubble masonry, coped with turf, is being constructed wherever revetment walls or precipices exist throughout the whole length of the line. Where the bank is sloping, oaken posts 6 inches thick are set at every 10 feet. I intended to connect them with a rail, but the pilfering propensities of the natives have interfered with this.

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* *See* Note, p. 15.

A dâk bungalow of the largest size is being completed at Dhurmpore, where the roads to Kalka, Kussowlee, Dugshai, and Subathoo diverge.

21. It may be satisfactory to show here the probabilities of the financial success of a carriage-road from the plains to Simlah, or in other words the probability of the scheme being a remunerative one.

In the first place, the distance by this new road from the plains to Simlah is 56 miles, which, upon the opening of the tunnel and the completion of other improvements, will be reduced to 50 miles. The distance by the old road, (which is practicable only for porters and lightly laden beasts of burden,) is 42 miles. The present ascertained traffic is above 8,000 tons per annum, without calculating the occasional increase consequent on the presence of the Head Quarters of the Government at Simlah.

The average cost of transit is Company's Rupees 50 per ton; the total annual cost is not probably less than 4½ lakhs of Rupees. When the new road is fairly opened for carts, this traffic will be doubled, as the potatoe grounds of Mahasoo will as easily supply [illegible]0,000 tons of potatoes as they now supply so many cwts. The iron of Kotkhai and Shiel may be produced ten-fold beyond the quantity now exported, which is 5,000 cwts. The Deodar forests of the Putteealah and Keunthul States may as well furnish timber for the buildings of Umballah, as for those of Kussowlee and Dugshai. Simlah will become the entrepôt of Hill produce instead of Loodianah and Sirhind, and when Railways intersect India, it will be the summer residence of the European public of the Presidency.

Whether the Government retain the transit in their own hands, issue licenses, or establish tolls, the Annual Returns ought not to be less than 15 per cent upon the outlay.

But Dugshai and Subathoo have yet to be taken into account. The annual cost of transmitting Commissariat Stores to these Stations is not less than Company's Rupees 10,000. A saving of 50 per cent. upon this will at once be the consequence of the establishment of carriage traffic.

The present average cost of marching a Regiment from Kalka to either of these Stations is Company's Rupees 2,000-0-0.

The cost of the same by means of carts will be less than Company's Rupees 500-0-0. The outlay at present upon the transit of market goods, and private stores, is not probably less than two lakhs of Rupees.

It has been stated by some that the annual repairs of this road will be enormous. This opinion is proved to be erroneous, by the fact that the roads hitherto constructed are at this present moment in as good condition as they ever were, and the total amount expended in three years, on the repairs of 78 miles, has been Company's Rupees 8,312-15-5, or Rupees 35-8 5 per mile per annum. As the traffic increases it will probably be necessary to metal certain portions of the line, but it is to be supposed that the increased traffic will afford increased income.

But far above and beyond these considerations is the opening out of the fertile valleys of these mountains to future European colonists. Blessed with a climate not surpassed in Europe; possessed of a soil which requires but the labor of man to produce any thing; pregnant with minerals of unknown value and extent; abounding in virgin forests, the depths of which have not yet heard the sound of the woodman's axe; all and far more than the early colonists of America ever promised themselves is to be found here, where, under the blessings of a mild and paternal Government, the colonist might increase his store, as fully assured of safety to life and property, as if the scene were in the heart of Great Britain, instead of under the shadows of the mighty Himalayas. Instead of permitting the old worn out European pensioner to idle away all that is left to him of life, under the scorching sun of Chunar, it might be worthy the attention of Government to give him a cottage and a spot that he might call his own, within some of these elevated valleys, where, with something to occupy his time, he might, under proper superintendence, lay the foundation of an European colony, the youth of which, educated to a military life in the neighbouring "Lawrence Asylum" and "Roorkee College," might furnish our Indian Army with recruits as strong, and better educated and acclimated, than the mother-country produces.

22. I will now proceed to show what *progress* has been made on the works to the North of Simlah on the line towards Thibet, and should objection be taken to it, I beg that it may be borne in mind that in the Himalayan *working* year there are not above 190 days.

From the end of November to the end of March, it would be fatal to the laborers to be encamped at elevations above 6,000 feet, and again during the wet season, there are many days when work must be deferred. Add to this the great natural difficulties to be encountered, the limited amount of laborers that are procurable from the Northern

States, the fact that these are changed every fifteen days, thereby entailing on the Road Overseers a continual and most harassing amount of training, the benefits of which they are never destined to reap, and the frequent desertions of entire working parties at perhaps most critical times, and the wonder will not be how little has been accomplished but rather that any thing has been effected at all. With the exception of two breaks of 2 and 3 miles respectively, 115 miles of 6-feet road are completed.

In this there is one abnormal portion temporarily admitted, in order to avoid the tremendous cliffs which line the Nogurree torrent. A few general improvements are required, but the whole is practicable for laden mules and horsemen. At present the working parties are pushed forward to Wangtoo on the Sutledge, where I hope they will be able to continue at work during the winter, and by next spring I expect that but 25 miles will remain of unfinished work between Simlah and Chini, and 60 between Simlah and the frontiers of China.

23. Where *all* is so difficult, it appears scarcely necessary to particularize special works. There are a few however which I will briefly notice. A tunnel 560 feet in length has been driven through a hill 2½ miles North of Simlah and not the least remarkable circumstance connected with this work is that it was constructed almost entirely by convict labor. The night reliefs were alone composed of free laborers, and a few of the same class assisted during the day in wheeling barrows and in such works as the convicts' chains rendered irksome. In the excavation of this work 10,000 convicts* and 8,450 free laborers were employed. At the market rate of labor, it would have cost Company's Rupees 1,057-0-0, but as a certain amount was furnished as *tribute*, it only cost Company's Rupees 391-0-0. A further sum of Company's Rupees 220-0-0 was expended on artificers, so that the total cost of the tunnel to Government was Company's Rupees 611-0-0. The period occupied in its construction was twelve months. Considering the valuable work thus obtained from convict labor, I cannot refrain from expressing my disappointment that since the completion of this tunnel, I have been wholly deprived of the services of the few prisoners that were employed on it.

The next heavy works are at the cliffs under Phagoo, which have been cut down to a depth of 120 feet.

* *See* Note, p. 15.

Between Theog and Mutteeanah three strong and handsome viaducts have been erected. One of these is 2■ feet in length. Beyond Mutteeanah the tremendous range of cliffs, which extend at intervals over a mile and a half, have been cut down to the depth of 130 feet, so that a 10-foot road now runs through this range of precipices where formerly a goat could not have found standing room. From Bowlee to Thedah the road is carried for 5 miles through one continuous range of cliffs. Before reaching Serahun it passes through the fearful precipices that overhang the Munglad, and beyond Serahun it is cut for half-a-mile through a sheer mass of rock.

The number of laborers employed upon these works has been 8,83,564,* the cost of which, after deducting Company's Rupees 40,000-0-0, as stated in paragraph 17 to have been subscribed by four States, has been Company's Rupees 77,685-0-0 or Company's Rupees 706-3-7 per mile. The expenditure on material, with the exception of powder, has been trifling; of this, 60,000 pounds have been expended. Eight staging bungalows have been erected at a cost to the State of Company's Rupees 9,990-5-7.

24. A few remarks upon the material used in the construction of the road works, and found in the neighbourhood of the line, do not appear to be irrelevant to the subject of this Report; and first with reference to *building timber.*

It appears to be a normal condition of the Himalayan forests that they shall have a Northern aspect, the flanks of the mountains facing that quarter being alone covered with tree vegetation. So much is this the case that a traveller from the Southward is at first impressed with the barren appearance of the mountains and the utter absence of forest scenery. When, however, he has penetrated further into the interior and turns his face Southwards, he is made aware of the erroneousness of his first impression, by the extensive breadths of dark pine forests he finds he has passed. To account for this singular fact, several reasons may be adduced, although none appear wholly satisfactory. It may be from the accumulation of snow on the Northern flanks during the winter, which protects the young plants from the severe frosts, and affords an inexhaustible supply of moisture during the summer, or perhaps from the general dip of the strata being towards the South, from which those slopes have an even and regular declination,

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* *See* Note, p. 15.

but retain no depth of soil, from the facility with which it is washed off, whereas, from the disintegration of the Northern exposed edges, deep deposits accumulate receiving yearly increase in depth and richness from the debris of decayed vegetation. So rich does this soil become, that at elevations between 8 and 12,000 feet, some of the most delicate of European vegetables and flowers are naturally produced. Asparagus, celery, rhubarb, strawberries, gooseberries, raspberries, *scented* violets, primroses, potentillas, anemones, cowslips, are all plentiful.

From the Hindostan and Thibet Road following the left or South bank of the Sutledge, it necessarily passes through several extensive forests, but the majority of the trees furnish timber of little value except as fuel. The immense forest extending from the Shallee Peak in the Bujjie State, to Turandah in Kunawur, (a distance of at least 100 miles), does not contain one tree in a thousand capable of yielding good durable timber. Within this distance there are a few patches of Pinus deodar, than which there can be no finer timber, and at a lower elevation many strips of Pinus longifolia fit for deal boards and battens, but the mass of the forest is of Pinus excelsa and Abies Smythiana, the timber of which much resembles that of the spruce fir of Europe, and is of little use except for fuel. From Turandah upwards, the Pinus deodar becomes more abundant, and when approaching the arid uplands of Thibet, it, with the Pinus Gerardiana, (the *neoza* or edible pine,) forms the general tree vegetation.

Without stopping to notice the Deodar forests of the Putteealah, Keunthul and Kotee Chiefs within ten miles of Simlah, out of which have been built the Sanataria of Dugshai, Kussowlee, Subathoo, and Simlah, and which, from the short-sighted rapacity and negligence of the Chiefs, have been ruthlessly destroyed and not replanted.*

I shall briefly mention the position and extent of the other patches of deodar, which I before stated occur occasionally on the left bank of the Sutledge, before reaching the comparatively high point of Turandah on that river.

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* "I should here state that active measures for the regeneration of these forests "are now in progress under the zealous superintendence of Lord W. M. Hay, Superin-"tendent of Hill States, and that as many seedlings still exist, they may yet afford at a "future period valuable resources for timber to the Government."—*Vide Letter from Superintendent Hill Roads, dated 10th March* 1856.

Near the summit of the Shallee Peak, there are some eight hundred trees of large dimensions, growing at a general elevation of 5,000 feet above the Sutledge, and separated from it by 5 miles of a rough descent.

At Kotegurh there is a young healthy strip of forest, which however is not likely to prove more than sufficient for the local demand.

In several of the deep valleys between Kotegurh and the neighbourhood of the Loongreo Pass, at Bowlee and at Dharun, all stages on the Hindostan and Thibet Road, there are several groves of deodar, but all of limited extent, and held sacred by the villagers as their household gods. These all exist at very long distances from the Sutledge.

Besides these patches there are of course many individual trees of deodar amongst the dense mass of inferior pines, but they are in no place sufficiently numerous to deserve special notice, and can only be discovered after considerable search. The same forests also produce walnut, maple, horse-chestnut, hazel, several cedars, and two oaks, (*quercus incana* and *quercus semicarpifolia.*) the timber of which is tough and durable. It is little used by the hill-men on account of the difficulty of working it, and the crooked nature of the tree rendering it not easily adaptable for building purposes. I consider this timber as peculiarly well adapted for railway sleepers, and carriage and waggon trucks. Appendix C gives the weight per cubic foot, and transverse strength of deodar, P. longifolia, and the two kinds of oak, as experimentally determined at various places on the road.

It is not until reaching Turandah that the deodar becomes sufficiently abundant within a moderate distance of the river, to suggest the possibility of floating the timber down to the plains. The rocky nature of the bed of the Sutledge within the hills, and the rapidity of its fall has until lately been held to render improbable the success of any attempt to float timber from a high elevation. But an experiment commenced by Mr. Edwards, and carried out by Lord William Hay, has proved the possibility of doing so, and although the result of the experiment was not satisfactory in a financial point of view, this was attributable to causes which I believe to be remediable.

The great fact of the possibility of floating timber of almost any dimensions, from a high elevation on the Sutledge to a point where rafts may be constructed, was proved. The following were the causes of the want of success in a pecuniary point of view :—

First.—The difficulty of transporting the timber from where it was felled to the river, in consequence of the precipitous nature of the country.

Second.—The perishable nature of the timber floated down, four-fifths of it being P. longifolia.

Third.—The unnecessary delay of two years in forwarding it to Ferozepore, arising from the timber having been cut too late to take advantage of the floods in the Sutledge, without which there was not sufficient water to float them down, and—

Fourth.—The want of a proper establishment at Belaspore, where the current becomes sufficiently easy to allow of rafts being formed.

The first of these difficulties, and the only one I consider necessary to notice, I would remove by the erection of a slide between the forest and the river. Turandah itself is not suitable for such an arrangement, as the forest is not sufficiently extensive and the ground between it and the river is too precipitous. The capabilities of Nachar, (the next stage,) are far greater. There are two forests in that neighbourhood, one to the south-east, consisting of 900 splendid trees, averaging in girth 9½ feet, and in height 115 feet. The maximum girth measured was 24 feet, the minimum 4 feet. Trees of greater dimensions exist, and even reach the enormous girth of 37 feet. The other forest is immediately above the village of Nachar and contains 20,000 sound trees, averaging in girth 8 feet, and in height 110. The direct distance of these forests from the river, is 2,100 yards, the first 800 yards of which is at an average slope of 20°, the next 500 yards are at 22°, and the last 800, (down to the river's edge) vary from 35° to 40°. I was apprehensive that these last gradients would prove too steep for the efficient working of a slide, but I have since constructed an experimental slide at an angle of 40° and found it to answer every requirement. The frequency and depth of the inflections render a diagonal line along the hill-side impossible. I now feel perfectly confident of the success of this scheme, which I recommended to Government in 1852. The probable cost of the erection of the slide would be 10,500 Rupees, and the Ferozepore value of the timber which might be *daily* sent down by it, from May to September, (whilst the river is flooded,) Rupees 3,000.

Three lakhs worth of the finest timber, of a scantling fit even for the Bombay market, might be *annually* supplied by such an arrangement

during the next seven years. The selling price at Ferozepore for building timber of deodar is, twelve annas per cubic foot. I will warrant, should Government be pleased to approve of my suggestions, the delivery at that point on the Sutledge of any quantity of prime wood at four annas per cubic foot.

But before sending down timber to be used in the Punjaub, where it is exposed to the ravages of the white ants, I would recommend the precaution of rendering it impregnable to their attacks by the infusion of some antiseptic substance into the sap of the growing tree. Appendix D. gives the result of four experiments made by me during the past year, which, it will be seen, were entirely successful. Fifteen days sufficed for the impregnation and destruction of the growing trees. They were felled, and on being sawn up, the sulphate of copper with which they had been destroyed was observed to have colored almost every portion of the timber. Four logs were sent to Captain Johnson, Assistant Quarter-Master-General at Umballah, who in the beginning of July had them buried with four unimpregnated logs in a spot swarming with white ants. They were dug up in November, having been four months under ground, when it was found that all the unimpregnated timber, with the exception of one log of deodar, was more or less destroyed, whilst the impregnated logs, with the exception of one in which the infusion had not penetrated the Alburnum, and which was consequently slightly excoriated by the insects, were in perfect condition. The fact of the infusion refusing to pass by the Alburnum is remarked by Lindley; ("Introduction to Botany," volume 2, page 326.)

The probable cost of thus insuring the durability of the timber will be half an anna per cubic foot, if impregnated with sulphate of copper and salt; or one anna, if with sulphate of zinc.

Before leaving this subject, I am desirous of pressing on the notice of Government the necessity for making arrangements for the purchase and preservation of the deodar forests of the Himalayas bordering the Sutledge, Pabur, and other rivers. These, with scarcely an exception, exist in independent States to which we accord protection. It is a remarkable fact, that more than one of the Chiefs of these States owe their positions to our generosity rather than to any right derived from birth, and yet there are no more rapacious dealers in any market, when they find that the Government are in want of any article they possess. Should Government direct a revision of their "Sunnuds," with a view

to increase the tribute they pay, these Chiefs would represent their estates to be nearly worthless, but, if within their Chiefships, the Government should require a barren hill for a Sanatarium, the price demanded would be such as might be asked were the ground as productive as the wheat fields of Kent.

The forests of the *far* Himalayas are profitless to the Chiefs and consequently neglected. The natural grasses underneath are of more value to the villagers of the neighbourhood than the tall pines above, which shade them and check their growth. Fire strengthens the grass and removes the offending giant trees, and thus whole forests fall before the improvident braud of the hill-man.

The Nachar forest shows a belt of dry sticks and blackened stumps, 500 feet wide and 2,000 feet long, where, but a few years back, existed some 3,000 noble deodars. But let a Government Official express a wish for but *one* tree, and the price demanded would be such as to startle the most uncompromising advocate of "free trade." Far in the interior of one of these States I lately required for the public service a few trees of P. excelsa from a very extensive forest, to make charcoal, and although the timber of this tree is absolutely worthless, the price demanded was equivalent to that obtained in Simlah for the best deodar. I observe as one of the causes of the pecuniary failure of Mr. Edwards' scheme for floating down timber, that the Rajah of Bussahir charged Government two Rupees per tree for the common P. longifolia cut in the virgin forests of Kunawur, which, even in the neighbourhood of the Simlah market, would not have been worth half that price.

Were Government now pleased to express a desire to cut timber in the Nachar forests, I feel confident that however worthless they are at present to the Rajah of Bussahir, the sum he would demand would be almost prohibitory, as far as the success of the scheme financially is considered. I would therefore earnestly solicit permission to ascertain *accurately* the extent and value of the best deodar forests on either side of the Sutledge and Pabur, and *at once* arrange with the Chiefs the purchase of a certain portion of them, (say, as much as Rupees 50,000,) at a fair valuation. The forests having once become the property of Government should be properly guarded, and means for their extension adopted. The planting of the hill side, above and below the Hindostan and Thibet road, with fine timber trees is another part of the same project which may be thought worthy of the attention of Government.

27. I will now briefly describe the iron ore exposed by the road excavations, or lying in the vicinity of its course.

It is first met with near Kundrelah close to where the two great spurs of Simlah and the Chor bifurcate, and it extends at intervals over 200 square-miles of the latter spur. The species is " magnetic iron" and it occurs in very dark iron-black grains disseminated in veins throughout the mica schist. I believe it to be similar in its external, physical, and chemical characters, to the magnetic iron ore of Norway and Sweden. In two districts, Kotkhai and Shiel, it has long been worked by the hill-men, and from its malleability is much prized in the Indian market.

Near Kundrelah, where the Hindostan and Thibet Road lays open the mineral, the ore enters too intimately into the composition of the compact mica slate, in which it occurs, and bears too small a proportion to the matrix, to afford a profitable return ; but nine miles to the eastward and close to the Pabur river, the entire side of a mountain, rising 1,500 feet from the valley below, and reaching an elevation of 7,000 feet above the level of the sea, was found to contain numerous rich veins of magnetic ore disseminated amongst the mica schist which was here of the most friable nature. A land-slip on one face of the hill afforded the inhabitants of the neighbouring villages the means of procuring the ore without the expense of excavating.

So disintegrated are the particles of ore, that on a stream of water being brought over the mineral veins, the shale is washed off and the ore as a coarse granular black powder remains. The expense of procuring the ore in this state does not exceed three annas per cwt. The percentage of iron obtainable from it is 52·17.

Having obtained a grant of 5,000 Rupees for the experimental working of these mines, a locality was selected where ore, wood, water, and flux, were obtainable at the least practicable cost. Ore was excavated with the sanction of the Rajah of Bussahir, on a condition that he should receive a percentage, (hereafter to be fixed,) upon the iron produced from the furnace.

The sole right of cutting wood over eighty acres of fine forest in the neighbourhood of the mines, I obtained from the villagers of Shiel, on favorable terms. With proper coalings the yield of charcoal from this forest should not be less than 7,000 tons, but within a circle of ten miles there are forests capable of yielding as many millions of tons.

A strong stream of water flowed through the valley, at an elevation which admitted of a portion being led to the mines, by a cut, one mile and a half in length. With proper management power sufficient to drive machinery. may be so obtained. Lime, as a flux, was obtained for the carriage within a distance of three miles.

The result of the last few months' working has been the construction of the water-course, the erection of necessary store-houses and work-shops, the completion of one blast furnace, and the semi-completion of two others, on European principles, with several of Native construction, the washing and storing 170 tons of ore, and the burning and storing of a large quantity of charcoal.

The estimated cost at which (if working on an extended scale,) we can turn out iron, is 35 Rupees per ton, but by the introduction of machinery, the air-furnace, or better still, the hot blast, I feel confident that the Himalayan iron-works of Shiel might be brought to produce iron at the same rates as those of Merthyr-Tydvil and Glasgow, of a superior quality. I have hitherto received practical assistance in the direction of the works from Assistant Overseer Neilson, a son of the large iron-founder of Glasgow, but illness has deprived me of his services and until I can obtain a qualified person to conduct the European mode of smelting the ore, the yield will be but small and precarious.

I have marked upon the map the situation of the iron mines and would direct the attention of Government to their favorable position, with reference to the navigation of the Tonse, which, for six months of the year, I am inclined to think would prove no impossibility for flat-bottom barges.

28. The system of accounts which obtains on all works connected with the Hindostan and Thibet Road, from its efficient working during five years is deserving of notice in this Report. It is based on a system of checks, which, if the Superintendent of Works does his duty, affords the best security against fraud. It has proved successful with fifteen different works in hand, and I am confident would do the same with five times that number, and with any amount of expenditure. That it has been successful is owing to the separation in all details of the Accountant's Department from that of the Executive, by placing at its head a responsible party qualified for the duties of an Accountant.

The appointment of Mr. T. Graham relieved the Superintendent of the Road of all responsibility of details in accounts, and by doing so,

afforded him increased opportunities of giving his time and attention to the constructive duties of his Office. I feel assured that the appointment of an efficient Accountant in Divisions of Public Works, where extensive operations are in progress, would, so far from increasing the cost of the works, effect a large reduction in expenditure, as it would render the principal Officer and his subordinates more efficient, inasmuch as their time and attention would be wholly devoted to the economical construction of the Public Works entrusted to their charge.

Requisition for advances for the payment of laborers are sent into the Office by Officers in charge of Divisions, and Overseers in independent charge of Sections. The Accountant examines their respective accounts, and if they exhibit close balances, he forwards their requisition to the Superintendent who affixes his signature and returns them to the Office, when the money is immediately despatched. In cases of emergency, the Accountant is authorized to comply with requisitions in anticipation of sanction.

The amounts of these advances are entered to the debit of the parties in a waste cash-book. Overseers, or others in charge of Sections, submit *daily* to the Superintendent lithographed Reports of the number of men and artificers on each description of work under their charge, and as the system of daily payments to laborers is enforced on this work, a certificate to the following effect is entered at foot of the "Daily Report."

"We do hereby certify that the numbers returned in this Report
" were present on this day, and employed solely on Government Works,
" and that the sums specified were paid to the laborers of each State
" by A. B. in the presence of C. D. and E. F.

" ————————, *Overseer,*
" *In charge of Section.*"

" ———————————— }
" *Officer in charge of Division.* }

These Reports are aggregated in eight-day reports, (or three reports per month,) which accompany an abstract exhibiting the amount of cash received in advance on requisition; the amount of pay accounts for labor, and bills for materials expended, and incidental charges, for all of which vouchers or receipts are requisite. These, after having been " passed" by the Superintendent, are closely examined as to their particular correctness by the Accountant. The debit side of these abstracts

relieves the waste cash-book, and the credit side, (or items of expenditure), is transferred to the day-book, whence the items are posted to their respective Divisions.

At intervals of three months, or on completion of any particular work, a general inspection of the accounts is made by the Superintendent, who, after careful audit, attaches his signature to the totals of each book, and furnishes a certificate of such audit, which, with the vouchers, are deposited with the office records. An audit of this kind precedes the preparation of the Half-yearly Accounts Current submitted to the Accountant, North-Western Provinces.

Bills for the expenditure upon sanctioned works are upon their completion submitted to the Auditor General,* and from him are sent to the Accountant General, who speedily relieves the Superintendent of the Road from his responsibility for their amount. Independent of tools and material which are supplied on Indent by the various Ordnance Magazines, many articles of a local character are required for the works. These are either manufactured on the works, or obtained from contractors and tradesmen. They are entered to the debit of the General Stock Account, which obtains a corresponding credit by debit to the particular Division or work upon which they have been expended. Previous to any material being ordered, the signature of the Superintendent is affixed to the Indent, which has been previously signed by the Overseer and countersigned by his Officer, as absolutely necessary. At the beginning of each month, these Indents are forwarded to the Superintendent, in support of accompanying bills, for the cost of material, the items of which, with their prices, are tested by the Accountant. The bills, if satisfactory to the Superintendent, receive his sanction and form vouchers either for monthly contingent bill submitted to Government, or for the general bill for works.

The whole of the permanent establishment is paid as soon as possible after the first of each month, and a receipt taken from each individual. These are deposited in the Office as vouchers for the establishment abstract, the details of which are entered in the day-book, and each Division or work debited with its share. By these means the Road Officers and Overseers are reciprocally checks upon each other in the matter of disbursements, and the Superintendent and Accountant in the matter of accounts.

* To the Secretary in this Department—*Ed.*

Every month a Progress Report is furnished to Government which exhibits the amount of work executed in each Division, the number of laborers employed, and the amount of cash expended.

The following books are kept in the Office :—

1*st.*—Divisional Ledger, in which are entered from the Day Book the various items of expenditure incurred in each Division.

2*nd.*—The Day Book, in which all items of expenditure are entered with numeral references to Ledger and Vouchers.

3*rd.*--Cash Book, in which assignments and valuation statements are debited, and all audited bills credited.

4*th.*—Waste Cash Book, in which are entered all advances on account of works.

5*th.*—Bill Book, in which all Bills are entered, and endorsed with copy of Civil Auditor's passing.

6*th.*—Indent Book, for tools, stores, and materials, obtained on indent.

7*th.*—Stock Book.

8*th.*—Official Letter Book.

9*th.*—Demi-official ditto and Circulars.

29. Having stated the result of our operations during the past five years, I will now briefly show the work still to be done.

With reference to the road between Simlah and the plains, I have nothing further to propose. Within six months I fully anticipate its completion to a minimum width of 15 feet, which is sufficient for general carriage traffic. Much of the road will be above 20 feet in width, but 15 will be the minimum within the parapet walls.

The extensive works connected with the Dugshai tunnel will not be completed for three years, but as before stated, this will not affect the general usefulness of the line.

With the exception of the tunnel, I already possess funds sufficient for the completion of this part of the road.

The Military road from Kussowlee to Buddee, to open out a direct communication between the Punjab and the Military Sanataria, is under course of completion.

With respect to the road from Simlah to the Chinese frontier, I must consider it to terminate in the neighbourhood of the first Chinese village met with, Shipké, as beyond that we cannot work without the sanction of the Chinese Government. Besides, as formerly stated, when once that point is reached, all obstacles to carriage by beasts of burthen cease.

Broad tracks formed from the most ancient times by the constant passage of horses and other baggage animals, communicate with the cities of Central Asia and Western China, and the only difficulties they exhibit are those incidental to a thinly populated country lying at a general elevation of 15,000 feet.

About 70 miles of very difficult road still remain unfinished, and to that which has been reported completed to 6 feet in width, several improvements are required.

The monthly grant for these works has hitherto been limited to 3,000 Rupees. I have already solicited its increase to 6,000 Rupees, in order to ensure the more speedy completion of the works.* With this grant for a period of three years, I feel confident of finishing the entire line from Simlah to the Chinese Territories, level almost throughout its whole extent, and broad enough for the transport of goods on mules and horses. I have further proposed the erection of Staging Bungalows at every 12 miles at a total cost of Rupees 16,000-0-0.

30. I cannot close this Report without bringing to the notice of the Governor General in Council, the zeal and intelligence displayed by the several Officers who have assisted in bringing these important works to their present forward condition. Lieutenant Dawson, (now Executive Officer in the Punjab,) and Major Cautley, (retired list,) each showed the most praiseworthy energy and perseverance in carrying out my orders, at times too when difficulties of no ordinary magnitude opposed, and when from the apathy and indolence of the hill-men, the greatest discouragements were placed in our way. Lieutenant Johnson, of the 33rd Native Infantry, (now Assistant Quarter-Master-General at Umballah,) and Lieutenant Montgomerie of the Engineers, each for some time in command of the 5th Company of Sappers and Miners, attached to the road, entered entirely into the spirit of the work, and gave me assistance as fully and cheerfully as if they had been Officers of the Road Department. Since their removal to higher employ, Mr. T. W. Knowles, Assistant Executive Officer, an intelligent and zealous young man, and Lieutenant Price, 31st N. I., have done what they could to further the work. The latter has lately been succeeded by Lieutenant Houchen, of the 55th N. I., who I have reason to believe will afford me every satisfaction in the discharge of his duties.

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* This has been granted.—*Ed.*

Of the Accountant's Department I have before spoken, and will, therefore merely state my entire satisfaction with the manner in which the head of it, Mr. Graham, has conducted his duties.

I will venture to say that no class of men in India have undergone greater privations with cheerfulness and unremitting attention to their duties than the Assistant Overseers of the Department of Public Works, and the Non-Commissioned Officers of the Sappers and Miners, attached to this road. They have been required to remain under canvas *in all seasons*, and these, within the Himalayas, embrace the extremes of temperature.

Some have been for years attached to distant Divisions in the far interior, shut out from intercourse with their comrades, and deprived of many of the comforts of life.

Of the usefulness and general good conduct of the small detachments from Her Majesty's 22nd, 32nd, 53rd, and 98th Regiments, which have been from time to time employed on this road, I cannot speak too highly. They are zealous, honest, and hard-working men; some of them have fitted themselves for independent charge of Sections; one of them who could neither read nor write when he joined the work, now conducts the duties of an Assistant Overseer to my perfect satisfaction. As the 20 Rupees per mensem they now receive as Staff Allowance is small in a country where provisions are dear, I have to solicit the sanction of Government to an increase of 10 Rupees per mensem to the allowances of those men whom I may find worthy of it.*

The value of such men, in operations such as this, cannot be overrated, and were their services more generally available, a great saving, both in *money* and *time*, would be manifest in the Public Works of India.

DAVID BRIGGS,

Superintendent, Hill Roads.

SIMLAH;
The 19*th December* 1855.

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* This has been sanctioned.—*Ed.*

APPENDIX.

APPENDIX A.

Being Major J. P. Kennedy's Paper on the principles of Hill Road-making, has already been printed in a separate form.

APPENDIX B.

Statement showing the Population of the Hill States, and the quotas of paid laborers demanded for the construction of the Hindostan and Thibet Road.

Names of States.	Population Census 1855.	Quotas demanded.	Remarks.
Bussahir,...	1,50,000	600	Never above 500 present.
Bhagul,...	21,600	100	
Bujjie, ...	9,000	50	
Bughat and Burrowlee, ...	10,000	90	Never above 50 present.
Bulsun, ...	4,800	35	
Dhamee, ...	2,800	20	
Hindoor, ...	50,600	160	
Joohul,...	17,200	115	
Kylure, ...	60,800	180	
Keunthul,......	25,700	115	With Thakooreeahs.
Koonharsen, ...	7,800	60	
Koonyar,......	1,900	10	
Kotkhai, ...	5,900	45	
Kotaha,...	8,900	30	
Kotgurh,...	2,700	20	
Mylog, ...	7,300	55	
Putteealah, ...	48,800	215	
Sirmoor, ...	75,500	200	
Turoche, ...	3,000	20	
Total, ...	5,12,300	2,120	

DAVID BRIGGS,

Superintendent Hill Roads.

APPENDIX C.

Table showing the Results of Trials on pieces of Himalayan Timber, each piece an inch square, and sustained by supports 24 inches apart, the Weight being applied in the middle of the length. The pieces were imperfectly seasoned.

Description of Timber.	Weight of a Cubic Foot in pounds.	Comparative Stiffness or Weight that bent the Piece eleven-twentieths of an inch.	Comparative Strength or Weight that broke the Piece	Remarks.
		Pounds.	Pounds.	
Pinus Deodar, ...	41·5	190	228	Broke short without splitting.
Pinus Longifolia,*......	50·5	171·5	304·5	Ditto ditto ditto ditto.
Quercus Incana, ...	73·75	230·	245·5	Split near centre.
Ditto Semicarpifolia, ...	73·	245·	335·	Ditto ditto one support.
Ditto Robur,†	50·47	Unknown.	322	Broke short without splitting.
Ditto Sessiflora,†	54·97	Unknown.	350	Broke short without splitting.

* This was less seasoned than the other pieces.

† These are taken from Tredgold's Experiments made in England, and placed here to assist comparison.

DAVID BRIGGS,

Superintendent Hill Roads.

APPENDIX D.

Experiments made at Simlah to test the efficacy of infusing into growing Timber Antiseptic Substances for the purpose of rendering it impregnable to the attack of Insects.

Description of Timber experimented on.	Distinguishing mark of Specimen.	Nature of Antiseptic Substances employed.	State of Timber after being buried at Umballah for four Months.
Pinus Longifolia or "Cheel"	A, ...	Sulph. of Copper and Salt, ...	Alburnum slightly destroyed.
	B, ...	Ditto ditto ditto, ..	Sound as when buried.
	C, ...	Unimpregnated, ...	Destroyed by white-ants.
	D, ...	Ditto, ...	Ditto ditto ditto.
Pinus Deodar or "Keloo"	E, ...	Sulph. of Copper and Salt, ...	Sound as when buried.
	F, ...	Ditto ditto ditto, ..	Ditto ditto ditto,
	G, ...	Unimpregnated, ...	Partially destroyed.
	H, ...	Ditto, ...	In good preservation.

Note.—B and C were buried together.
G and H ditto ditto.
A and B were pieces of one tree.
E and F ditto ditto ditto.

DAVID BRIGGS,
Superintendent, Hill Roads.

Letter from Captain H. Yule, Under-Secretary to the Government of India, to Captain D. Briggs, Superintendent of Hill Roads, Simlah,

Dated the 4th February 1856.

PUBLIC WORKS DEPARTMENT.

SIR,

I AM directed to acknowledge receipt of your letter forwarding your Report on the operations connected with the Hindustan Road, from 1850 to 1855.

2. This Report, I am desired to state, will be published as a No. of the Selections from the Records of the Government of India.

3. The Most Noble the Governor General remarks, that he can say nothing more laudatory, or more true of your exertions than that you have fully maintained since your return from furlough the reputation you had acquired before your departure. The Governor General, I am to add, will leave India with full confidence that the project of forming a road from the plains of India to Thibet, which His Lordship has regarded as of great importance in many ways, and in which he has taken a strong interest, will be completed in due time, and will be productive of all the benefits that have been anticipated from it.

4. To that end, the Government of India sanction the grant of Rupees 6,000 a month, which you have shown will be required to complete the road in three years to the Frontier.

5. I am instructed to offer to you, on the part of the Government, a renewal of the sentiments expressed to you in 1852,* together with the marked thanks of the Governor General in Council.

6. You are requested to convey to the Officers you have named, Lieutenant Dawson, Major Cautley, Lieutenant Johnson, and Lieutenant Montgomerie, Engineers, the thanks of the Government for their exertions in this work

7. I am also to express the full approbation of the Government to Mr. Graham, and to the body of Overseers, who well deserve the increase of pay you recommend (*viz.* Rupees 10 per mensem each,) which you are accordingly authorized to disburse.

H. YULE, *Captain,*
Under Secy. to the Govt. of India.

FORT WILLIAM,
The 4th February 1856.

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* *Extract from a Minute by the Most Noble the Governor General of India, dated the 6th July* 1852.

"Lieutenant Briggs had great difficulties to contend with. He overcame them all, and I desire to place upon record my personal admiration of, and my gratitude to, that valued young Officer for the scientific ability, the indomitable energy and perseverance, the indefatigable personal exertion at all seasons and under all circumstances; and the still rarer tact and suavity of disposition by which he was able to unite the exertions of all for the accomplishment of a common object, and to complete, in its main features, within a very short time, a public work which, I take leave to say, will prove to be, though it is now little known and trumpeted, as creditable in its motives, its execution, and its results to the Government of India, as any work which has come under my notice since I have been here.

* * * * *

"It is with great regret I add, that the report to which I have alluded has not been furnished, and that the work itself may, perhaps, be delayed in consequence of the serious illness of Lieutenant Briggs. Incessant exposure to the sun has struck him down, and he has been peremptorily ordered to proceed for a time to England.

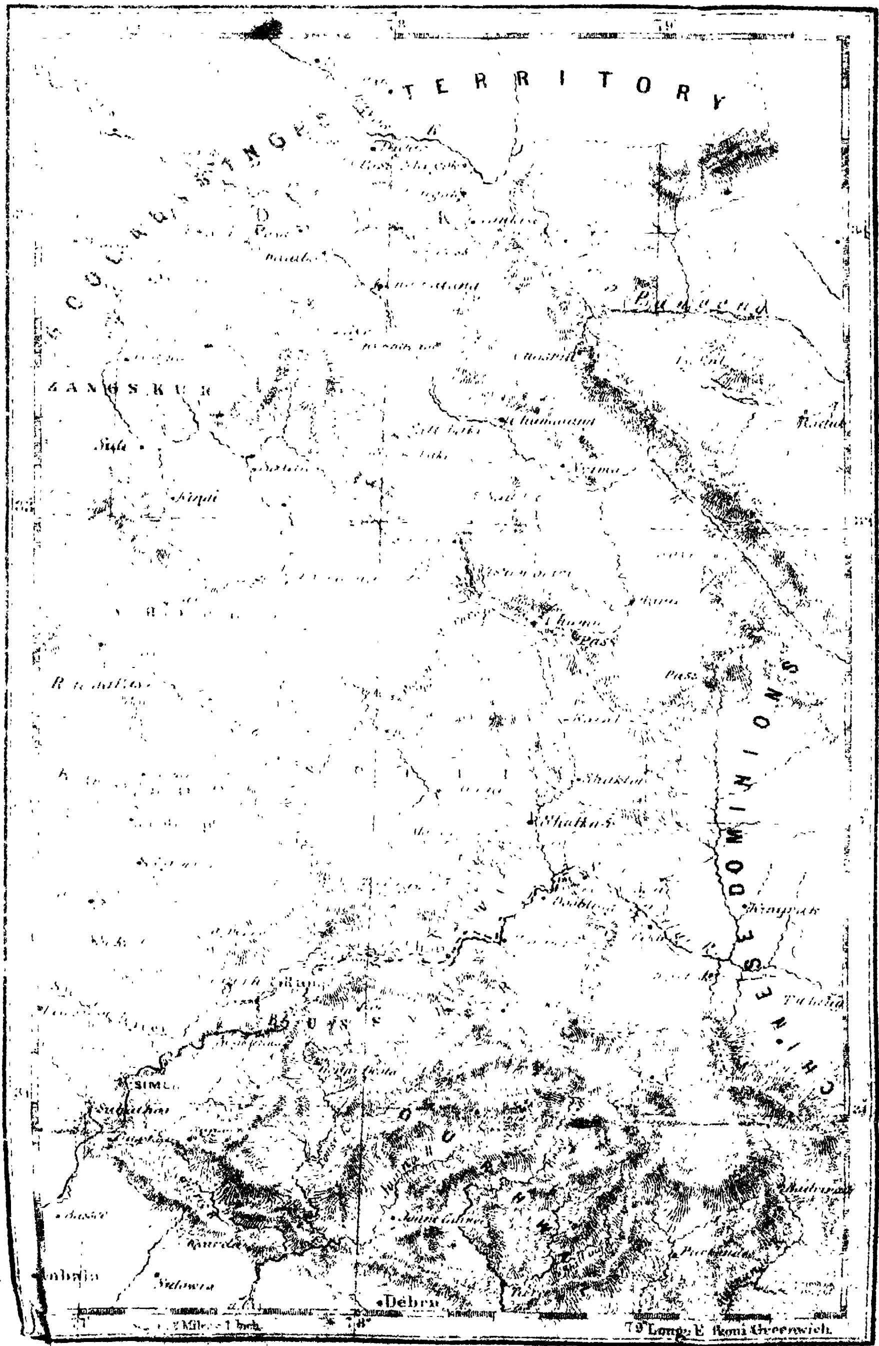
"I have felt it my grateful duty to speak of the merits of this Officer as they deserve, before his departure, and to express my hope, that whoever may administer the Government of India on Lieutenant Briggs' return, may have his attention drawn to talents and qualities which render that Officer peculiarly fitted to render most effective and valuable service to the Government of the country.

"I would propose that, with the concurrence of my colleagues, a copy of this record may be communicated to Lieutenant Briggs.

"DALHOUSIE."

INDEX MAP

to accompany Report on the HINDOOSTAN & THIBET ROAD for 1855.



SURVEYOR GENERAL'S OFFICE, CALCUTTA MAY

1856.